PB-240 225

BLACKHOOF LAKE, CROW WING COUNTY, MINNESOTA

Pacific Northwest Environmental
Research Laboratory

Prepared for:

National Environmental Research Center
Minnesota Pollution Control Agency
Minnesota National Guard

December 1974

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT

ON

BLACKHOOF LAKE

CROW WING COUNTY

MINNESOTA

EPA REGION V

WORKING PAPER No. 87

WITH THE COOPERATION OF THE

MINNESOTA POLLUTION CONTROL AGENCY

AND THE

MINNESOTA NATIONAL GUARD

DECEMBER, 1974

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Minnesota Pollution Control Agency for professional involvement and to the Minnesota National Guard for conducting the tributary sampling phase of the Survey.

Grant J. Merritt, Director of the Minnesota Pollution Control Agency, John F. McGuire, Chief, and Joel G. Schilling, Biologist, of the Section of Surface and Groundwater, Division of Water Quality, provided invaluable lake documentation and counsel during the course of the Survey; and the staff of the Section of Municipal Works, Division of Water Quality, were most helpful in identifying point sources and soliciting municipal participation in the Survey.

Major General Chester J. Moeglein, the Adjutant General of Minnesota, and Project Officer Major Adrian Beltrand, who directed the volunteer efforts of the Minnesota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

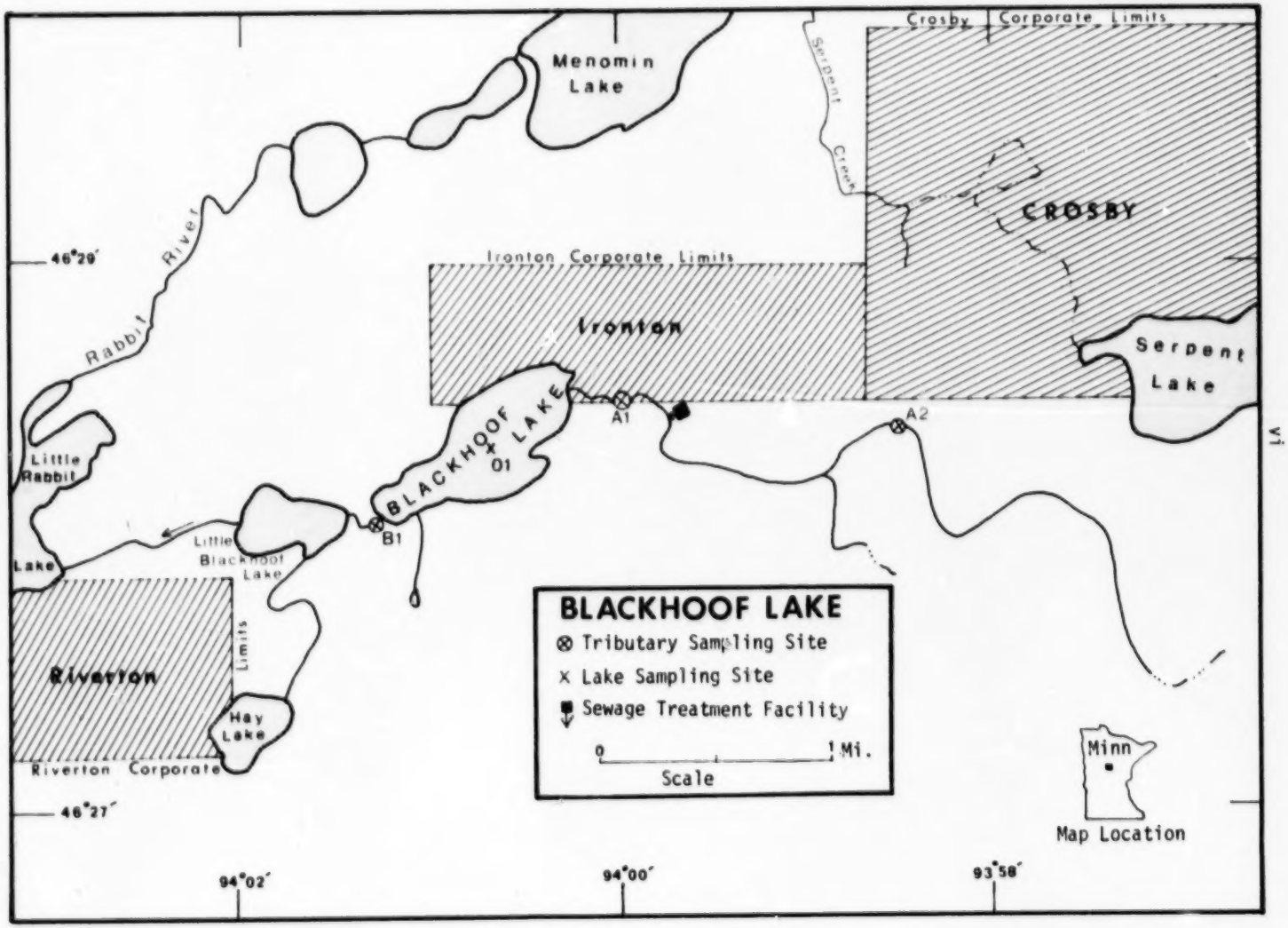
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MINNESOTA

LAKE NAME	COUNTY
Albert Lea	Freeborn
Andrusia	Beltrami
Badger	Polk
Bartlett	Koochiching
Bear	Freeborn
Bemidji	Beltrami
Big	Stearns
Big Stone	Big Stone, MN; Roberts, Grant, SD
Birch	Cass
Blackduck	Beltrami
Blackhoof	Crow Wing
Budd	Martin
Buffalo	Wright
Calhoun	Hennepin
Carlos	Douglas
Carrigan	Wright
Cass	Beltrami, Cass
Clearwater	Wright, Stearns
Cokato	Wright
Cranberry	Crow Wing
Darling	Douglas
Elbow	St. Louis
Embarass	St. Louis
Fall	Lake
Forest	Washington
Green	Kandiyohi
Gull	Cass
Heron	Jackson
Leech	Cass
Le Homme Dieu	Douglas
Lily	Blue Earth
Little	Grant
Lost	St. Louis

LAKE NAME	COUNTY
Madison	Blue Earth
Malmedal	Pope
Mashkenode	St. Louis
McQuade	St. Louis
Minnetonka	Hennepin
Minnewaska	Pope
Mud	Itasca
Nest	Kandiyohi
Pelican	St. Louis
Pepin	Goodhue, Wabasha, MN; Pierce, Pepin, WI
Rabbit	Crow Wing
Sakatah	Le Sueur
Shagawa	St. Louis
Silver	McLeod
Six Mile	St. Louis
Spring	Washington, Dakota
St. Croix	Washington, MN; St. Croix, Pierce, WI
St. Louis Bay	St. Louis, MN; Douglas, WI
Superior Bay	St. Louis, MN; Douglas, WI
Swan	Itasca
Trace	Todd
Trout	Itasca
Wagonga	Kandiyohi
Wallmark	Chisago
White Bear	Washington
Winona	Douglas
Wolf	Beltrami, Hubbard
Woodcock	Kandiyohi
Zumbro	Olmstead, Wabasha


Crosby Corporate Limits
Menomin Lake
Serpent Creek
CROSBY
Ironton Corporate Limits
Ironton
Rabbit River
46°29'
Serpent Lake
A1
A2
BLACKHOOF LAKE
01
Little Rabbit Lake
B1
Little Blackhoof Lake
Riverton
Limits
Hay Lake
Riverton Corporate
46°27'
BLACKHOOF LAKE
⊗ Tributary Sampling Site
x Lake Sampling Site
Sewage Treatment Facility
0
1 Mi.
Scale
Minn
Map Location
94°02'
94°00'
93°58'

BLACKHOOF LAKE

STORET NO. 2712

I. CONCLUSIONS

A. Trophic Condition:

Survey data show that Blackhoof Lake is eutrophic. Of the 60 Minnesota lakes sampled in the fall of 1972, when all essentially were well-mixed, 25 had less mean total phosphorus, 30 had less mean dissolved phosphorus, and 19 had less mean inorganic nitrogen. For all Minnesota data, 29 lakes had less mean chlorophyll a, and 25 had greater Secchi disc transparency.

Depletion of dissolved oxygen with depth occurred in July and September.

B. Rate-Limiting Nutrient:

The results of the algal assay indicate nitrogen limitation at the time the sample was collected. The lake data indicate nitrogen limitation during the July and October sampling periods and a borderline phosphorus limitation during September.

C. Nutrient Controllability:

1. Point sources--During the sampling year, the Ironton wastewater treatment plant is estimated to have contributed over 71% of the total phosphorus load to the lake.

The present loading rate of about 10 lbs/acre/yr or 1.13 $g/m^2/yr$ is more than twice that proposed by Vollenweider (in

press) as "dangerous"; i.e., a eutrophic rate (see page 12). Removal of 85% of the phosphorus at Ironton would reduce the loading rate to 4.3 lbs/acre/yr or 0.48 $g/m^2/yr$ (a eutrophic rate); 100% removal would reduce the loading rate to 3.2 lbs/acre/yr or 0.36 $g/m^2/yr$ (a mesotrophic rate). If the latter level of control can be achieved, the trophic condition of Blackhoof Lake should improve.

2. Non-point sources--Non-point sources accounted for 27.9% of the total phosphorus load reaching Blackhoof Lake during the sampling year.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 183 acres.
2. Mean depth: 14.5 feet.
3. Maximum depth: 30 feet.
4. Volume: 2,654 acre/feet.
5. Mean hydraulic retention time: 257 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
Unnamed Stream (A-1)	5.8 mi^2	3.8 cfs
Minor tributaries & immediate drainage -	1.9 mi^2	1.4 cfs
Totals	7.7 mi^2	5.2 cfs

2. Outlet -

Unnamed Stream (B-1)	8.0 mi^2**	5.2 cfs

C. Precipitation***:

1. Year of sampling: 28.8 inches.
2. Mean annual: 24.8 inches.

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† DNR lake survey map (1969); mean depth by random-dot method.
* Drainage areas are accurate within ±5%; mean daily flows are accurate within ±10%; and ungaged flows are accurate within ±10 to 25% for drainage areas greater than 10 mi^2.
** Includes area of lake.
*** See Working Paper No. 1, "Survey Methods".

III. LAKE WATER QUALITY SUMMARY

Blackhoof Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two or more depths at a single station on the lake (see map, page vi). During each visit, a single depth-integrated (15 feet to surface) sample was collected for phytoplankton identification and enumeration, and a similar sample was collected for chlorophyll a analysis. During the last visit, a single five-gallon depth-integrated sample was taken for algal assays. The maximum depth sampled was 21 feet.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake was essentially well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (10/24/72)		
Temperature (Cent.)	5.1	5.3	5.3	5.4
Dissolved oxygen (mg/l)	11.0	11.1	11.2	11.2
Conductivity (μmhos)	225	229	230	230
pH (units)	8.1	8.2	8.2	8.3
Alkalinity (mg/l)	101	103	103	103
Total P (mg/l)	0.033	0.047	0.049	0.058
Dissolved P (mg/l)	0.015	0.030	0.032	0.040
NO_2 + NO_3 (mg/l)	0.080	0.087	0.090	0.090
Ammonia (mg/l)	0.040	0.050	0.050	0.060
		ALL VALUES		
Secchi disc (inches)	54	62	60	72

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/02/72	1. Anabaena	29,273
	2. Microcystis	2,091
	3. Dinobryon	1,000
	Other genera	270
	Total	32,634
09/04/72	1. Microcystis	627
	2. Merismopedia	602
	3. Anabaena	313
	4. Melosira	313
	5. Coelosphaerium	289
	Other genera	856
	Total	3,000
10/24/72	1. Melosira	3,735
	2. Anabaena	2,620
	3. Asterionella	1,898
	4. Fragilaria	813
	5. Flagellates	663
	Other genera	1,175
	Total	10,904

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/02/72	01	19.8
09/04/72	01	5.7
10/24/72	01	*

* Sample lost.

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho Conc. (mg/l)	Inorganic Conc. (mg/l)	Maximum yield (mg/l-dry wt)	N/P Ratio
Control	0.028	0.266	5.6	10/1
0.005 P	0.033	0.266	4.9	8/1
0.010 P	0.038	0.266	5.5	7/1
0.020 P	0.048	0.266	6.1	6/1
0.050 P	0.078	0.266	7.1	3/1
0.050 P + 10.0 N	0.078	10.266	26.2	132/1

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Blackhoof Lake was moderately high at the time the sample was taken. The lack of significant increase in yield with increasing levels of orthophosphate, until nitrogen was also added, shows that the sample was nitrogen limited. Note also, the N/P ratio of the control sample.

The lake data indicate nitrogen limitation in July (N/P ratio = 7/1) and October (N/P = 5/1) and phosphorus limitation in September (N/P = 14/1).

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Minnesota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff months of April and May when two samples were collected. Sampling was begun in October, 1972, and was completed in September, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Minnesota District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the mean annual concentrations in the unnamed stream at station A-2 and mean annual ZZ flow.

The Village of Ironton did not participate in the Survey, and the nutrient loads were estimated at 2.5 lbs P and 7.5 lbs N/capita/year. The nutrient loads attributed to the inlet are those measured at station A-1 minus the estimated Ironton loads.

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* See Working Paper No. 1.

A. Waste Sources:

1. Known municipal† -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Ironton	562	act. sludge	0.056*	Unnamed stream

2. Known industrial - None

† Anonymous, 1974
* Estimated at 100 gal/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Unnamed Stream (A-1)	360	18.1
b. Minor tributaries & immediate drainage (non-point load) -	170	8.5
c. Known municipal STP's -		
Ironton	1,410	70.9
d. Septic tanks* -	20	1.0
e. Known industrial - None	-	-
f. Direct precipitation** -	30	1.5
Total	1,990	100.0

2. Outputs -

Lake outlet - Unnamed Stream (B-1) 310

3. Net annual P accumulation - 1,680 pounds

* Estimate based on 25 lakeshore dwellings; see Working Paper No. 1.
** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Unnamed Stream (A-1)	9,750	50.8
b. Minor tributaries & immediate drainage (non-point load) -	2,870	14.9
c. Known municipal STP's -		
Ironton	4,220	22.0
d. Septic tanks* -	590	3.1
e. Known industrial - None	-	-
f. Direct precipitation** -	1,760	9.2
Total	19,190	100.0

2. Outputs -

Lake outlet - Unnamed Stream (B-1)	11,190

3. Net annual N accumulation - 8,000 pounds

* Estimate based on 25 lakeshore dwellings; see Working Paper No. 1.
** See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs $P/mi^2/yr$	lbs $N/mi^2/yr$
Unnamed Stream (A-1)	62	1,681

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining olgiotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumulated
lbs/acre/yr	10.9	9.2	104.9	41.7
grams/m^2/yr	1.22	1.03	11.8	4.9

Vollenweider loading rates for phosphorus ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Blackhoof Lake:

"Dangerous" (eutrophic rate)	0.48
"Permissible" (oligotrophic rate)	0.24

V. LITERATURE REVIEWED

Anonymous, 1974. Wastewater disposal facilities inventory. MPCA, Minneapolis.

Schilling, Joel, 1974. Personal communication (lake map). MPCA, Minneapolis.

Vollenweider, Richard A., (in press). Input-output models. Schweiz A. Hydrol.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 2712 BLACKHOOF LAKE

TOTAL DRAINAGE AREA OF LAKE 7.96

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
2712A1	5.83	1.57	1.46	2.11	6.06	7.52	6.26	4.97	3.91	2.86	3.24	2.96	2.37	3.78
2712H1	7.96	2.32	2.19	2.99	8.40	10.30	8.53	6.81	5.45	3.85	4.50	4.16	3.35	5.25
2712Z7	2.13	0.79	0.67	0.96	2.07	2.63	2.33	1.76	1.29	1.06	1.10	0.94	1.01	1.39

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 7.96
SUM OF SUB-DRAINAGE AREAS = 7.96
TOTAL FLOW IN = 61.90
TOTAL FLOW OUT = 62.85

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2712A1	10	72	3.02	15	3.20				
	11	72	3.30	19	3.00				
	12	72	2.69	21	2.79				
	1	73	2.09	6	2.10				
	2	73	1.83	4	1.90				
	3	73	3.25	16	3.20				
	4	73	3.76	9	3.60	24	4.40		
	5	73	4.81	3	4.20	20	4.30		
	6	73	4.01	11	4.40				
	7	73	7.42						
	7	73	2.63	13	2.60				
	8	73	3.40	17	3.60				
	9	73	3.83	17	3.60				
2712H1	10	72	4.19	15	4.30				
	11	72	4.64	19	4.20				
	12	72	3.80	21	3.80				
	1	73	3.09	6	3.10				
	2	73	2.74	4	2.90				
	3	73	4.60	16	4.60				
	4	73	5.29	9	5.00	24	6.10		
	5	73	5.05	3	5.20	20	4.50		
	6	73	3.75	11	4.10				
	7	73	3.61	13	3.50				
	8	73	4.74	17	5.00				
	9	73	5.16	17	4.80				

TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 2712 BLACKHOOF LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
271227	10	72	1.02	15	1.00				
	11	72	1.05	19	0.90				
	12	72	1.15	21	1.10				
	1	73	1.05	6	1.10				
	2	73	0.84	4	0.90				
	3	73	1.48	16	1.50				
	4	73	1.30	9	1.20	24	1.50		
	5	73	1.29	3	1.30	20	1.20		
	6	73	1.03	11	1.10				
	7	73	0.93	13	0.91				
	8	73	1.13	17	1.20				
	9	73	1.42	17	1.30				

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/10/30

271201
46 28 18.0 094 00 38.0
BLACKHOOF LAKE
27 MINNESOTA

11EPALES
3

2111202
0023 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/02	10	05 0000	24.0	10.2	72	200	8.60	96	0.040	0.040	0.040	0.013
	10	05 0020	8.5	0.0		230	7.20	105	0.060	0.540	0.188	0.088
72/09/04	16	30 0000	18.9		54	275	8.00	94	0.090	0.130	0.020	0.013
	16	30 0004	18.9	7.8		199	8.00	96	0.100	0.120	0.022	0.015
	16	30 0015	15.2	0.3		220	7.32	112	0.050	0.620	0.034	0.022
	16	30 0018	12.9	0.0		240	7.20	122	0.100	1.770	0.199	0.164
	16	30 0021	11.1									
72/10/24	11	45 0000			60	230	8.10	103	0.090	0.060	0.033	0.015
	11	45 0004	5.4	11.2		225	8.20	103	0.090	0.050	0.053	0.037
	11	45 0015	5.3	11.0		230	8.30	101	0.090	0.050	0.058	0.040
	11	45 0019	5.1	11.2		230	8.20	103	0.080	0.040	0.046	0.027

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/07/02	10	05 0000	19.8J
72/09/04	16	30 0000	5.7J

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY DATA

STORET RETRIEVAL DATE 74/10/30

2712A1 LS2712A1
46 28 30.0 093 59 30.0
UNNAMED EAST TRIB TO BLACKHOOF
27 CO #18 SHEET #2
I/BLACKHOOF LAKE
ST HWY 210 XING BELO IRONTON STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/15	12 40		0.360	0.725	0.092	0.052	0.176
72/11/19	14 45		0.317	0.690	0.087	0.080	0.138
72/12/21	14 40		2.600	5.000	1.400	0.200	0.390
73/01/06	14 30		1.160	0.890	0.170	0.105	0.240
73/02/04	09 30		1.360	0.585	0.069	0.132	0.220
73/03/16	09 00		0.310	1.000	0.199	0.086	0.165
73/04/09	09 15		0.273	1.600	0.032	0.078	0.130
73/04/24	10 40		0.110	0.480	0.013	0.063	0.090
73/05/03	13 55		0.055	0.460	0.065	0.069	0.090
73/05/20	11 45		0.010K	0.960	0.023	0.010	0.035
73/06/11	14 13		0.048	3.990	0.610	0.490	0.690
73/07/13	10 37		0.330	1.380	0.146	0.250	0.400
73/08/17	15 30		0.037	0.720	0.039	0.132	0.260
73/09/17	10 30		0.160	0.960	0.058	0.120	0.360

K VALUE KNOWN TO BE LESS THAN INDICATED

Reproduced from best available copy.

STORET RETRIEVAL DATE 74/10/30

2712A2 LS2712A2
47 29 00.0 093 58 30.0
UNNAMED STREAM
27 CO #18 SHEET#2
T/BLACKHOOF LAKE
SECONDARY RD BRDG S IRONTON
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	71430 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/15	12 30		0.077	0.750	0.120	0.007	0.054
72/11/19	14 30		0.026	0.580	0.078	0.019	0.039
72/12/21	14 50		0.014	1.080	0.370	0.015	0.034
73/01/06	15 00		0.044	1.000	0.260	0.015	0.070
73/02/04	10 15		0.034	0.580	0.379	0.011	0.025
73/03/16	08 40		0.085	1.050	0.252	0.028	0.065
73/04/09	09 25		0.037	1.900	0.087	0.029	0.050
73/04/24	10 45		0.022	0.630	0.039	0.015	0.035
73/05/03	14 00		0.010K	0.890	0.040		0.025
73/05/20	12 30		0.063	0.890	0.026	0.090	0.125
73/06/11	13 50		0.022	1.400	0.072	0.026	0.070
73/07/13	10 50		0.010K	1.400	0.094	0.038	0.090
73/08/17	15 20		0.010K	0.970	0.040	0.032	0.075
73/09/17	10 45		0.010K	0.940	0.080	0.035	0.085

K VALUE KNOWN TO BE LESS THAN INDICATED

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STORET RETRIEVAL DATE 74/10/30

2712B1 LS2712B1
46 28 00.0 094 01 00.0
UNNAMED STREAM
27 CO #18 SHEET #2
T/BLACKHOOF LAKE
CO HWY 28 BRDG SSW IRONTON
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/15	12 45		0.041	0.962	0.110	0.005K	0.037
72/11/18	15 00		0.010K	0.850	0.014	0.006	0.033
72/12/21	14 15		0.096	1.200	0.019	0.006	0.042
73/01/06	14 30		0.280	0.860	0.270	0.013	0.030
73/02/04	10 35		0.220	0.880	0.050	0.005K	0.022
73/03/16	16 00		0.350	1.320	0.132	0.010	0.035
73/04/09	09 00		0.180	0.870	0.110	0.007	0.040
73/04/24	10 35		0.168	0.680	0.010	0.005K	0.035
73/05/03	13 45		0.033	0.860	0.012	0.011	0.030
73/05/20	12 00		0.010K	0.780	0.009	0.008	0.020
73/06/11	14 20		0.010K	1.200	0.013	0.007	0.020
73/07/13	10 30		0.010K	0.955	0.019	0.005K	0.025
73/08/17	15 10		0.010K	0.810	0.011	0.011	0.030
73/09/17	10 20		0.010K	1.760	0.070	0.011	0.030

K VALUE KNOWN TO BE LESS THAN INDICATED

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